MI-0187

Short summery of my visit to FERMILAB

(11 August to September 10 1996), Ch. Steinbach

Talks given

1) Short one about the principles of slow extraction at the CERN PS, together with M. Martens and J. Johnstone for comparison with the extractions from the Tevatron and the proposed one from the Main Injector (August 15).

2) Long one on the details of the resonant extraction from the CERN PS and a few related topics on LEAR extraction and low frequency ripple compensation by phase displacement technique (August 22).

3) Operation of the CERN PS: principles and methods used in injection, acceleration and extractions and description of the various beams (September 5).

The preparation of talks took a long time, particularly for the last one, which needed to gather various documentation from my own files, from the WEB, from Faxed documents or documents made accessible by my CERN colleagues through the WEB. The possibilities in this domain are astonishing nowadays, but of course the time consumed in is important. As an example, getting color transparencies on the printer network turned out to be unreliable and time consuming to a frustrating degree. I should mention that R. Hively was very helpful in dealing with this kind of problems.

Visits

An extensive and highly interesting complete tour of the MI construction work with P. Martin on August 14.

A short but very fruitful visit of the Tevatron extraction regions with M. Martens on August 21, during machine shut-down.

Some time spent in Control Room on several occasions, the longest one on Sunday September 8. I was impressed by the knowledge and the professionalism of the Operation teams and found some interesting features in the controls and beam instrumentation system, in spite of its age: sampling and plotting facilities, SWIC profiles, vocal alarms etc.

Very complete visit of the neutron therapy center with B. Pientak.

Private discussions

Several meetings with W. Chou on the operation of the CERN hadron complex with an emphasis on the various losses during the whole process.

Various discussions with M. Martens and P. Prieto on extraction from the Tevatron, with observations in the Control Room.

Some (unfortunately short) contacts with J. Johnstone on the planned extraction from the MI. He gave me all the parameters necessary to enter data in my simulation program.

Simulation of MI extraction

I had to adapt my simulation program to the environment of the PC's at FERMILAB. Besides, some of the features had to be adapted to the half integer resonance. A certain number of

difficulties arose with some of the computers of the EE department. Thanks to P. Prieto, who kindly let me use his Pentium PC for extended periods, these problems were solved and I could produce fast results with complete plots and print-outs during the last days.

Results from the simulation program agree relatively well with J. Johnstone's study.

I find an emittance of .226 for a force of 3.8 10^{-4} m^{-1} in the first quad family as compared with the figure of .235 given by J. Johnstone

I find the emittance stable area for 4.38 10^{-4} m^{-1} in the first quad family as compared with the figure of 4.36 10^{-4} m^{-1} given by J. Johnstone.

There seem to be some interest in my program as a simple to use tracking and I tried to teach its use to J. Johnstone and P. Prieto and left them a copy of the updated version tailored to the half-integer resonance and the local environment together with MI data.

Comments on the MI extraction project

Time was too short to go into the details of the extractions from the MI, specially because they are somewhat dependent from each other as far as the element distributions and aperture problems are concerned. I have to limit myself to very general considerations.

The quads enlarge β_h at the Lambertson magnet but not at the first magnetic septum, which could be a valuable advantage for efficiency. In the Tevatron, a special high β has been implemented, and I wonder if this could be implemented here.

On the other hand, β_h is enlarged in other locations, such as the focusing quads, together with dispersion coefficients, which may become a problem for aperture.

The step size seems a little weak to me, with barely more than 5 mm. One should look into the possibility of enlarging it to the benefit of extraction efficiency. If it is limited by the strength of the harmonic quads, then I think it is a pity.

I wish I had time to compare in details the extraction from the tevatron to the proposed MI proposal. This could lead to excellent suggestions, thanks to the experience in the first one.

Medical accelerators

Very interesting interview of C. Ankerbrandt, who differs totally in his conception of a proton therapy accelerator from the ideas evolved within the Austron-Tera collaboration. We consider a slow cycling machine with slow extraction, he thinks a fast cycling one is more adapted to raster or voxel scan with one cycle per voxel. He claims this is the only chance to get near the 2% precision in dose required by the physicians. He gave me a copy of the PTA project paper (1992).

Discussions with J. Crisp about the spill at Loma Linda and its improvement by feedback with recordings from a visit at Loma Linda Hospital.

He and P. Martin provided me with documentation dating from the Loma Linda accelerator construction at FNAL.

I wish to thank all those who helped me during my stay at FERMILAB, and who tried to fulfill my most demanding requests.

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